REMARKS

Applicant has carefully reviewed and considered the Office Action mailed on January 8, 2007, and the references cited therewith. In the office action, claims 30-72 were rejected under 35 U.S.C. 112 first paragraph, as failing to comply with the written description requirement. Claims 30-72 were rejected under 35 U.S.C. 112 second paragraph as being indefinite. Claims 30-71 were rejected under 35 U.S.C. 102(b0 as being anticipated by Kuenstler et al. Claims 51-72 were rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over Wallin (5,670,270). Claims 30, 31, 36, 39-52, 57, and 60-72 were rejected under 35 U.S.C. 102(b) as anticipated by Liu et al. (5,478,444).

Claims 1-15, 20, and 27-29 are canceled; claims 16-19 and 21-26 are withdrawn; claims 30, 51, and 72 have been amended; and claim 31-50, and 52-71 were previously presented. Claims 30-72 are currently pending in this application.

§112 First Paragraph Rejection of the Claims

Claims 30-72 are rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement. Specifically, the specification was found not to provide support for the claim terminology set forth below.

> In Claim 30 – "said electron conducting ceramic phase comprising at least a portion that is not the product of a reaction involving the proton conducting ceramic phase;"

The phrase "said electron conducting ceramic phase comprising at least a portion that is not the product of a reaction involving the proton conducting ceramic phase" has been replaced with "wherein the amount of said electron conducting ceramic phase is above its percolation limit in the composite material." The latter phrase is supported in the specification in paragraph 24. Paragraph 24 states, "[t]he incorporation of doped CeO_2 [an electron conducting ceramic phase] above the percolation limit not only results in sufficient electronic conductivity to make the material and [sic] excellent mixed conductor, but also will improve the thermodynamic

stability of the composite material in the presence of CO_2 or H_20 over perovskite materials where no doped CeO_2 is added."

In Claim 30, 51, and 72 - "and wherein the material is substantially gas impermeable when sintered"

Claims 30, 51, and 72 have been amended to remove the word "substantially." This phrase, as amended, is supported in paragraphs 30 and 43 of the specification. Paragraph 30 states that the "pores in the structure, the very dark areas, are completely closed and do not allow gas flow across the membrane." Paragraph 43 states that the ". . . composite membrane tested at two feed gas flow-rates to demonstrate that there were no leaks in the system." Accordingly, this phrase is expressly, implicitly, or inherently disclosed in the specification.

In Claim 72 – ". . . wherein the amount of the electron conducting ceramic phase is sufficient to prevent the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water"

Applicant submits that this phrase is supported in the specification by paragraphs 24, 32, 35, and 37. Paragraph 24 states, "[t]he incorporation of doped CeO_2 above the percolation limit not only results in sufficient electronic conductivity to make the material and[sic] excellent mixed conductor, but also will improve the thermodynamic stability of the composite material in the presence of CO_2 or H_20 over perovskite materials where no doped CeO_2 is added." Thus, the specification supports that the amount of electron conducting ceramic phase (CeO_2) is sufficient to prevent the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water, where carbonate and hydroxide are known to those of skill in the art to cause instability.

Paragraph 32 discusses Example 2 in which a material was fabricated with an electron conducting phase and the material was tested for stability in reducing environments containing H_2O and CO_2. The tests (See Figure 2) indicate that the material was stable in the environments.

Accordingly, this paragraph implies that the amount of the electron conducting ceramic phase is sufficient to prevent the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water.

Paragraph 35 discusses an experiment performed to demonstrate that the materials in the present invention are more stable in oxidizing conditions in the presence of CO_2 and H_2O. The experiment showed "no noticeable carbonate formation in the non-stoichiometric [electron conducting phase] composite samples . . . ." Accordingly, this paragraph implies that the amount of the electron conducting ceramic phase is sufficient to prevent the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water.

One of ordinary skill in the art would know from reading the specification that sufficient quantities of the electron conducting ceramic phase will make the material more stable because the amount of the phase prevents the formation of carbonate in the presence of carbon dioxide and the formation of hydroxide in the presence of water.

§112 Second Paragraph Rejection of the Claims

Examiner has objected to the use of the word "substantially" as being unclear under 35 U.S.C. 112 second paragraph. Applicant has amended its claims to remove the word "substantially."

§102 Rejection of the Claims based on Kuenstler

Claims 30-71 were rejected under 35 USC §102(b) as being anticipated by Kuenstler et al (Physical Chemical Investigations).

At the outset, Applicant submits that its independent claims are not product-by-process claims and that *In re Thorpe* does not apply. The forgoing notwithstanding, Applicant respectfully disagrees that Kuenstler anticipates Applicant's claims as amended. The amount of Ceria in Kuenstler is insufficient to form an electron conducting phase. As Examiner notes, the Ceria is there as a product of a reaction, but for the reasons set forth below, the product of the Kuenstler reaction does not create the at least one contiguous pathway necessary to make the sintered material capable of conducting electrons.

First, it is helpful to keep in mind that Kuenstler's application is for a fuel cell. Fuel cells are inefficient if the material used is an electron conductor. The fuel cell would waste the energy (electricity) it is trying to create by leaking electricity. Although this point alone is better suited for a Section 103 discussion, any reference in Kuenstler should not be read to inherently support electron conduction because of the small presence of Ceria.

Second, Kuenstler's process produces as an unwanted byproduct "a small amount of CeO_2." See Section 2, page 326. Small amounts of Ceria are insufficient to create the contiguous path through the overall material necessary to for the composite material to be a conductor of electrons. It is known to those of skill in the art that about thirty percent of the material, or the percolation limit, is necessary to achieve a contiguous path, or conductivity. In US Pat. No. 6,187,157, a reference uncovered in preparation for preparing the office action response in this case, Chen, et al. discloses a multi-phase solid electrolyte ionic transport membrane conducting oxygen and electrons. Chen, et al. states,

> In a simple dual phase mixed conductor system comprised of an oxygen ion conductive material, the percolation theory is usually used to predict the volume fraction of the second (metallic) phase required to achieve electronic conductivity in a mixed conductor system. The value of the volume fraction typically falls in the range of about 30%, although this value can vary markedly, depending upon the relative sizing of the individual components.

Because Kuenstler's material is for use as a fuel cell, his use of small clearly means less than what would cause electron conductivity. If this were not the case, Kuenstler would not reference his material as a possible use in fuel cells as he does in the introduction of his paper. Thus, the small amounts of ceria produced by Kuenstler are insufficient to establish electronic conductivity, either by exceeding the percolation limit or be establishing at least one contiguous path through the composite material.

An additional factor to note is that the other by product in the Kuenstler process is BaO. The Kuenstler process produces ceria at the expense of Barium Cerate resulting in BaO according to the following formula

$$BaCeO_3 \Longrightarrow BaO + CeO_2$$

Thus, Kuenstler is a 3-phase mixture. It is known to those of skill in the art that BaO is neither a conductor of electricity, nor a conductor of protons. Furthermore, it is known that the presence of BaO makes the material unstable in the presence of CO_2 and H_2O at high temperatures. Ba in the material allows for the creation of Barium carbonate and Barium hydroxide in the presence of CO_2 and H_2O respectively. Thus, at a minimum, Kuenstler does not anticipate claim 72.

§102 and §103 Rejection of the Claims based on Wallin

Applicant submits that the Wallin reference is no longer be an appropriate Section 102 or 103 reference in light of the removal of the word substantially for the reasons set forth above and in the last office action response. Additionally, the Wallin reference discloses an oxygen conductor. Wallin does not disclose a proton conductor.

§102 Rejection of the Claims based on Liu

Applicant submits the Liu in an improper Section 102 reference because Liu doesn't teach a proton conducting ceramic phase. The perovskite structure used in the Liu reference does not create proton conductivity. It is know by those of skill in the art that the materials suggested by Liu are not stable in Hydrogen. For example, Liu suggest the use of lanthanum ferrite as the electron conductor. This material is unstable in hydrogen and thus would not be a suitable material for a proton conductor. The Liu reference is silent with regard to proton conductivity. Thus, the Liu reference does not teach a mixed phase material capable of conducting electrons and protons. Liu only teaches a mixed phase material capable conducting electrons and oxygen.

Conclusion

Again, Applicant expresses appreciation to Examiner for his time during the telephonic interview on March 5, 2007. Applicant respectfully requests reconsideration of its claims in light of the interview, the amendments, and the remarks.

Respectfully submitted,

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By his Representatives,

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Date 3/8/2007 By [signature]
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